DOCUMENT RESUME

ED 223 202 IR 010 453

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TITLE The Effect of Organizational Chunking and Retrieval Strategies in Facilitating Learning and Recall of Cognitive Learning Tasks.
PUB DATE May 82
NOTE 7p.; Paper presented at the Annual Meeting of the Association for Educational Communications and Technology, Research and Theory Division (Dallas, TX, May 1982). For other papers, see IR 010 442-487.
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS College Students; *Efficiency; Higher Education; *Instructional Design; Instructional Materials; Intermode Differences; *Learning Processes; *Recall (Psychology); Retention (Psychology); *Time Factors (Learning)
IDENTIFIERS *AECT Research and Theory Division Meeting; *Chunking; Organizing Strategies

ABSTRACT

Content organization and its effects on prose learning were the focus of this study. Organizational chunking during the encoding or reading interval with an instructional booklet and batched postquestions during the retrieval period (including all events between initial learning and the retention test) were used with 112 university students to determine the effectiveness and efficiency of experimenter-imposed organization utilizing these encoding and retrieval strategies. Major findings indicated that chunked treatment resulted in a more efficient learning strategy than the conventional treatment. Neither treatment, however, produced different learning outcomes as measured by postquestion identification and terminology testlike trials. Nor, at least on the comprehension test, did one encoding strategy prove more effective than the other. The intervening postquestion retrieval strategy did not improve comprehension test performance; however, subjects who received the intervening postquestion strategy took significantly less time to complete the performance measure than those who received the non-intervening treatment. Time, therefore should be considered an important variable in optimizing learning within the information-processing framework. Seventeen references are included. (LMM)

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THE EFFECT OF ORGANIZATIONAL CHUNKING AND RETRIEVAL STRATEGIES IN FACILITATING LEARNING AND RECALL OF COGNITIVE LEARNING TASKS

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IR010453

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The Effect of Organizational Chunking and Retrieval Strategies in Facilitating Learning and Recall of Cognitive Learning Tasks

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The purpose of this study was to investigate the effectiveness of efficiency of organizational encoding and retrieval strategies within an information-processing framework. The independent variables included organizational chunking and batched postquestions as strategies which facilitate learning and recall performance. The dependent variables consisted of a comprehension test which was chosen as an effectiveness measure because it represented a higher level instructional task and recorded time which was chosen as a efficiency measure. The problem addressed in this study directly related to the information-processing framework that looks at encoding and retrieval.

Statement of the Problem

Designer-produced materials offer great practical significance if an instructional designer can incorporate events that influence retention in an optimal manner. Gagne (1978, p. 637) groups the events of prose learning and retention into four phases: a) prelearning history; b) the events occurring just prior to reading, i.e., advance organizers, prequestions, objectives; c) the reading interval, i.e., imagery, inserted questions, organization; and d) a retention period that includes all events between initial learning and the retention test, i.e., postquestions, notetaking. This study, within the information-processing context, focused on manipulations within the last two phases since they parallel research in encoding and retrieval processes that affect learning from prose. Tulving (Thompson & Tulving, 1970; Tulving & Thompson, 1973) provides evidence for considering content organization as a process that encompasses both encoding and retrieval and provided a logical starting point for designing effective instruction.

The conception of verbal learning as a direct consequence of the process of organization is seen in the early work of G. A. Miller (1956). The organizational strategy of chunking that he described has been used extensively in explanations of verbal learning (McLean & Gregg, 1967). It has been suggested that better memory performance may result from the chunking of words into associative, syntactical, or other units because of the reduced memory capacity resulting from this formation of larger units (Eagle, 1967). Thus, the particular conception of organization that was utilized within this study was that of the chunking process. By manipulating this variable within a passage closely analogous to materials used in instructional settings, its effect on performance of a given outcome was observed. This encoding aid was thus the variable that occurred during the reading interval phase.

Retrieval aids appeared during what Gagne (1978) terms the fourth phase, a retention period that includes all events between initial learning and the retention test. Although much fruitful experimentation has been done with inserted questions (Frase, 1968; Rothkopf, 1970), this study viewed post-questions as a variable within the final phase rather than the reading interval phase. By placing all questions at the end of the instructional unit, the backward effect of these questions was able to be observed. As McConkie (1977, p. 25) points out, these questions "provide a review of the specific information being interrogated and greatly enhance the likelihood it will be retained on a later test". Further, by having these questions measure performance of learning outcomes different than the higher level performance task, their effect, as well as the chunking effect, was able to be ascertained.

Summary

This study was concerned with content organization and how it affects prose learning. The encoding process entailed by organization encompass both encoding and retrieval aids as they affect the memory or storage of the information to be learned. What processes produce different patterns of posttest performance on a measure requiring integrative ability? Is it the organization that occurred during encoding, the organization facilitated by a testlike review, or is it a combination of the two effects? To answer this question organizational chunking during the encoding or reading interval and batched postquestions during the retrieval period that includes all events between initial learning and the retention test were used to determine the effectiveness and efficiency of experimenter-imposed organization utilizing these encoding and retrieval strategies.

Statistical Design

A two factor (between subjects) design denoted as RS_n in $(A_2 \times B_2)$ was utilized in this study. Factor A: Two levels of organizational encoding, 1) organizationally chunked instructional materials and 2) conventionally ordered materials. Factor B: Two levels of organizational retrieval activities, 1) non-intervening postquestion, testlike conditions and 2) intervening postquestion, testlike conditions. All subjects were given the dependent criterion variable which was the comprehension test performance measure to determine instructional effectiveness. Time with the instructional booklet, time with postquestions, and time with performance measure were recorded to aid in determining instructional efficiency.

Consistent with the ideas of instructional psychology that suggest the value of particular types of acquisition activities being defined relative to the testing context (Bransford, 1979), this study focused on one particular criterion test of interest: the comprehension test. Dwyer (1978) indicated that the type of learning that this evaluation instrument was meant to measure was a higher level cognitive task, requiring a thorough understanding of the heart, its parts, its internal functionings, and the simultaneous processes occurring during the systolic and diastolic phases. Consisting of 20 multiple-choice items, the test gave the location of certain parts at a particular moment of its functioning and required the subject to locate the position of other specified parts of the heart (Dwyer, 1972). Thus, this task clearly requires the subject to integrate information. Therefore, this measure served as the dependent variable since it represents the kind of complex task of interest for this particular study.

The first independent variable consisted of two treatments; the modified, experimental treatment and the original, control treatment. The second independent factor in this design was interveing versus non-intervening postquestions test trials. Two of the original criterion tests were used, identification and terminology. Requiring learners to identify the numbered parts on a detailed drawing of the heart, the 20-item multiple-choice identification test measured the learner's ability to use visual cues to discriminate one structure of the heart from another and to associate specific parts of the heart with their proper name.

One of four treatments was randomly assigned as the 112 university volunteers appeared individually for their experimental session, resulting in a n=28 for each group. Each experimental treatment required that the subjects interact with an instructional booklet describing the parts and the functioning of the heart. Two of the groups received a booklet wherein the content had been chunked in terms of the functioning of the heart. Two other groups received a more conventional step-by-step linear booklet. One chunked group and one conventional group then received intervening batched postquestions during a retrieval interval before taking the comprehension test performance measure. The other groups had a non-intervening treatment and took the comprehension test performance measure immediately upon completion of the booklet. Separate times were recorded for 1) time with booklet, 2) time with postquestions, and 3) time with performance measures.

Eleven hypotheses were tested using a computerized two-way analysis of variance (ANOVES) program. Null hypotheses were rejected if an F-ratio with a p value of .05 or less was obtained. In addition to the analysis of the dependent measures, calculated efficiency scores were also analyzed to further determine the relative efficiency of the four experimental treatments. Comparisons were likewise made on differing learning outcomes as measured by the two types of postquestions.

Summary of Major Findings of Interest

The major findings of this study support the conclusion of Faw and Waller (1976) and McConkie (1977) that time is a significant variable to consider in instructional research. First, it was shown that the chunked treatment was more efficient in terms of instructional time spent with the booklet than the conventional treatment. Further, when efficiency scores were computed, it was demonstrated that the chunked treatment resulted in better performance on the comprehension test per unit of time spent with the instructional booklet than the conventional treatment. It was inferred from these differences that the chunked treatment resulted in a more efficient strategy for processing information and hence a different structural representation in memory of the information (Mayer, 1976; Mayer, 1978; Mayer & Greeno, 1972). The implication of this result for instructional designers is an important one, for it gives evidence to Glaser's (1976) contention that the designers may be in a position to optimize instruction by designing it in such a way that it approximates the most efficient method. Thus, organizational strategies improving information processing clearly occur at encoding, appear to affect memory storage, and can be built into the instruction.

In addition, this study also provided some insight into the significance of the organizational processes for retrieval (Postman, 1972). The intervening postquestions strategy did result in subjects taking less time on the performance measure than those not taking the postquestions (non-intervening group).

This increasing rate of retrieval is seen as support for the contention of Wortman and Greenberg (1971) and Buschke (1976) that storage becomes more efficient over time as a result of the mental review provided by the post-questions. This shows, once again, that time is a variable that must be seriously considered for optimizing learning within the information-processing framework.

Major findings indicated that the chunked treatment resulted in a more efficient learning strategy than the conventional treatment. The chunked and conventional treatments did not, however, appear to produce different learning outcomes as measured by the postquestion identification and terminology testlike trials. Nor, at least for the comprehension test performance measure, did noe encoding strategy result in more effectiveness than the other. The intervening versus the non-intervening postquestion retrieval strategy did not result in a performance difference on the comprehension test. There was, though, an interesting efficiency effect. By receiving the intervening post-question strategy, subjects took significantly less time completing the performance measure than those subjects who received the non-intervening post-question treatment.

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